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13. ABSTRACT (Maximum 200 words)  THIS FINAL REPORT DOCUMENTS THE PHASE I CONTAMINATION SURVEY OF SITE 36-8, TWO OPEN CHEMICAL DRAINAGE DITCHES. 10 SAMPLES FROM 4 BORINGS WERE ANALYZED FOR VOLATILE AND SEMIVOLATILE ORGANICS AND METALS WITH SEPARATE ANALYSES FOR AS, HG, AND DBCP. AS, HG, DLDRN, AND DIMP WERE DETECTED AT OR ABOVE THEIR RESPECTIVE INDICATOR RANGES. A PHASE II PROGRAM CONSISTING OF 25 ADDITIONAL BORINGS IS RECOMMENDED. THE VOLUME OF POTENTIALLY CONTAMINATED MATERIAL IS ESTIMATED AT 12,000 CUBIC YARDS. APPENDICES: CHEMICAL NAMES, PHASE I CHEMICAL DATA, COMMENTS AND RESPONSES.					
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ROCKY MOUNTAIN ARSENAL

FINAL PHASE I  
CONTAMINATION ASSESSMENT REPORT  
SITE 36-8: CHEMICAL DRAINAGE DITCH

April 1987  
Contract Number DAAK11-84-D0016  
Task Number 1 (Section 36)  
(Version 3.2)

Rocky Mc

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Rocky Mountain Arsenal  
Information Center  
Commerce City, Colorado

PREPARED BY

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.  
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EXECUTIVE SUMMARY

SITE 36-8 CHEMICAL DRAINAGE DITCHES

Site 36-8, Chemical Drainage Ditches, is in the western portion of Section 36 at Rocky Mountain Arsenal. The site consists of a northern ditch (36-8N) and a southern ditch (36-8S). This site was investigated under Task 1 in the spring of 1985. The site was constructed in 1962 and reportedly used for drainage of chemical wastes from Section 1 to a holding basin (Site 36-11) and from Basin A to Section 35 into Basin B (Site 35-3). A total of four borings yielding 10 samples were drilled to depths of 5 to 13 feet.

The following target analytes were detected within or above their respective indicator ranges: arsenic, mercury, cadmium, chromium, lead, dieldrin, and diisopropylmethyl phosphonate (DIMP). Samples from Ditch 36-8S contained detectable concentrations of dieldrin, as well as mercury concentrations above the indicator ranges. Samples from Ditch 36-8N contained detectable concentrations of DIMP and dieldrin, as well as mercury and arsenic at concentrations above the indicator range. These data indicate that soil contamination has occurred in and along the ditch segments. On the basis of these field investigations and the sources of historic information consulted, additional field investigations are warranted.

A Phase II program consisting of 25 additional borings yielding 58 samples is recommended to better define the lateral and vertical extent of contamination. On the basis of historical data and the information obtained to date, the estimated volume of potentially contaminated material above the water table at this site is revised from 8,000 cubic yards to 12,000 cubic yards.

## SITE 36-8: CHEMICAL DRAINAGE DITCHES

### 1.0 PHYSICAL SETTING

#### 1.1 LOCATION

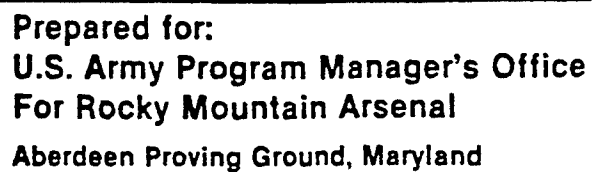
Site 36-8 at Rocky Mountain Arsenal (RMA) consists of two open chemical drainage ditches, designated 36-8N and 36-8S for clarity. The northern ditch (36-8N) is manmade and extends from the north end of Basin A to the western edge of Section 36 (Figure 36-8-1). This ditch then enters Section 35 (Site 35-4) and drains into Basin B (Site 35-3). The southern ditch (36-8S) is a natural drainage channel which extends from the South Plants Area north around the liquid storage pool (Site 36-11) and exits on the western edge of Section 36. This ditch then drains northward through Section 35. This site (36-8N and 36-8S) has previously been estimated to occupy 22,200 square feet (ft<sup>2</sup>) (RMACCPMT, 1984, RIC#84034R01). The surface elevations at this site range from 5,235 ft above mean sea level (ft msl) at 36-8N to 5,241 ft msl at 36-8S.

The alignment of the southern ditch (2,000 linear ft) was defined by aerial photograph interpretation and field confirmation. However, the alignment of the segment which crosses Sites 36-4 and 36-20 was uncertain, as it has been disturbed by extensive earth moving. The northern ditch (1,600 linear ft) is less clearly defined.

#### 1.2 GEOLOGY

The soil profile in the vicinity of this site is formed on a 30- to 40-ft mantle of unconsolidated alluvial and aeolian deposits of Quaternary Age. The material is composed primarily of valley fill, dune sand, and terrace gravel which contain interbedded silty clay, silt, sand, and gravel (Kolmer, J., 1975, RIC#81266R34; RMACCPMT, 1983, RIC#83326R01). The Denver Formation forms the bedrock surface in the area and underlies the surficial deposits. The unit consists of 250- to 450-ft of clay-shales and siltstone





interbedded with largely fine- to medium-grained, lenticular, sandstone and lignite beds. Volcaniclastic debris may also be present (May, 1982, RIC#82295R01; Anderson et al., 1979, RIC#85214R03; Clark, J., 1985, RIC#85183R01).

Results of the boring program confirm that this site is underlain by alluvial materials consisting of silty sands and sandy clays. The northern portion of Site 36-8 has a clay layer at a depth of approximately 9 ft as shown on the log for Boring 3184 in Figure 36-8-2. The southern portion is underlain by silty sands to the depths explored (11 ft).

### 1.3 HYDROLOGY

The surface topography surrounding both drainage ditches is relatively flat with a slight slope toward the ditches from the outlying areas including Basin A (Figure 36-8-3). Surface water runoff enters the ditches from these areas and then flows north-northwest via the ditches into Section 35. A 1964 aerial photograph showed that a new ditch constructed to the south appeared to drain the Basin A fluids into Section 35 and that portions of 36-8N have been filled in (Stout et al., 1982, RIC#83368R01). Aerial photographs revealed that Site 36-8S flowed into a holding basin until sometime between 1970 and 1975. A 1975 aerial photograph also revealed that a new ditch constructed in Section 35 is a continuation of 36-8S through Section 35. No surface water quality data pertinent to Site 36-8 are available.

The general direction of ground water flow over RMA is northwest. Within Section 36 flow direction varies from northeast to west due to local bedrock influences. Flow at Ditch 36-8S is to the north and ground water flow beneath Ditch 36-8N is north-northwest (Figure 36-8-4). A ground water contour map generated from water level data gathered in March 1986 (ESE, 1986c, RIC#86238R08) (Figure 36-8-4) indicates that the water table elevation ranges from approximately 5,235 to 5,255 ft msl at 36-8S and 5,220 to 5,227 ft msl at 36-8N.

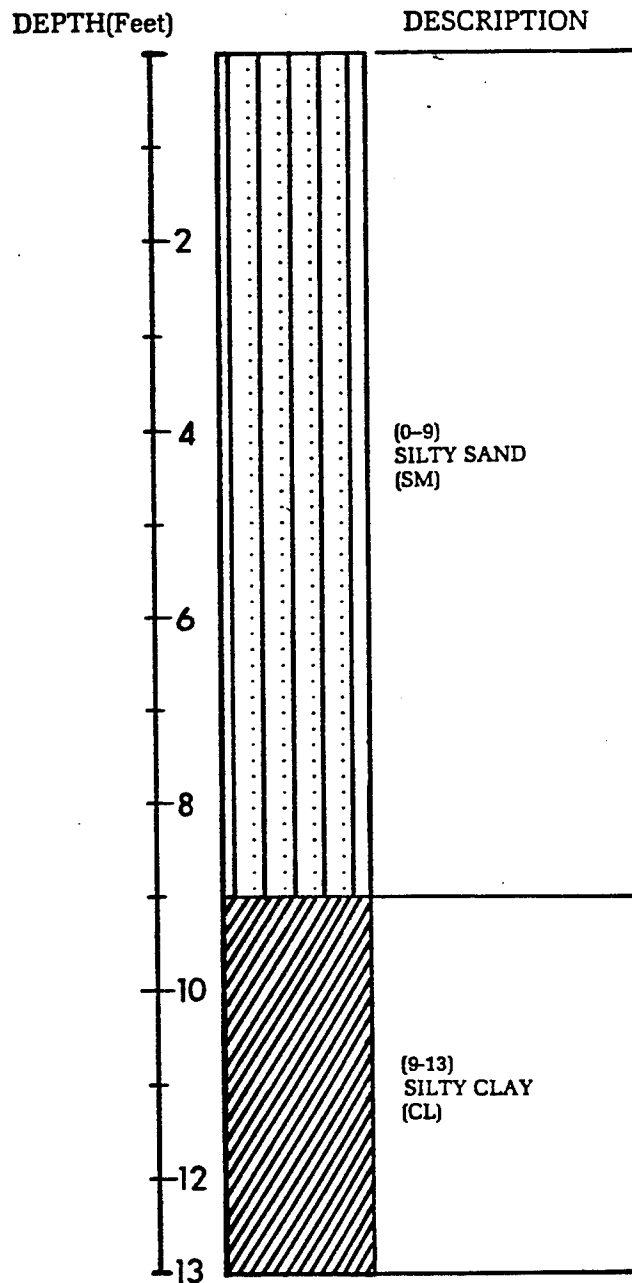


Figure 36-8-2  
FIELD BORING PROFILE FOR BORING 3184  
SOURCE: ESE, 1987

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Aberdeen Proving Ground, Maryland

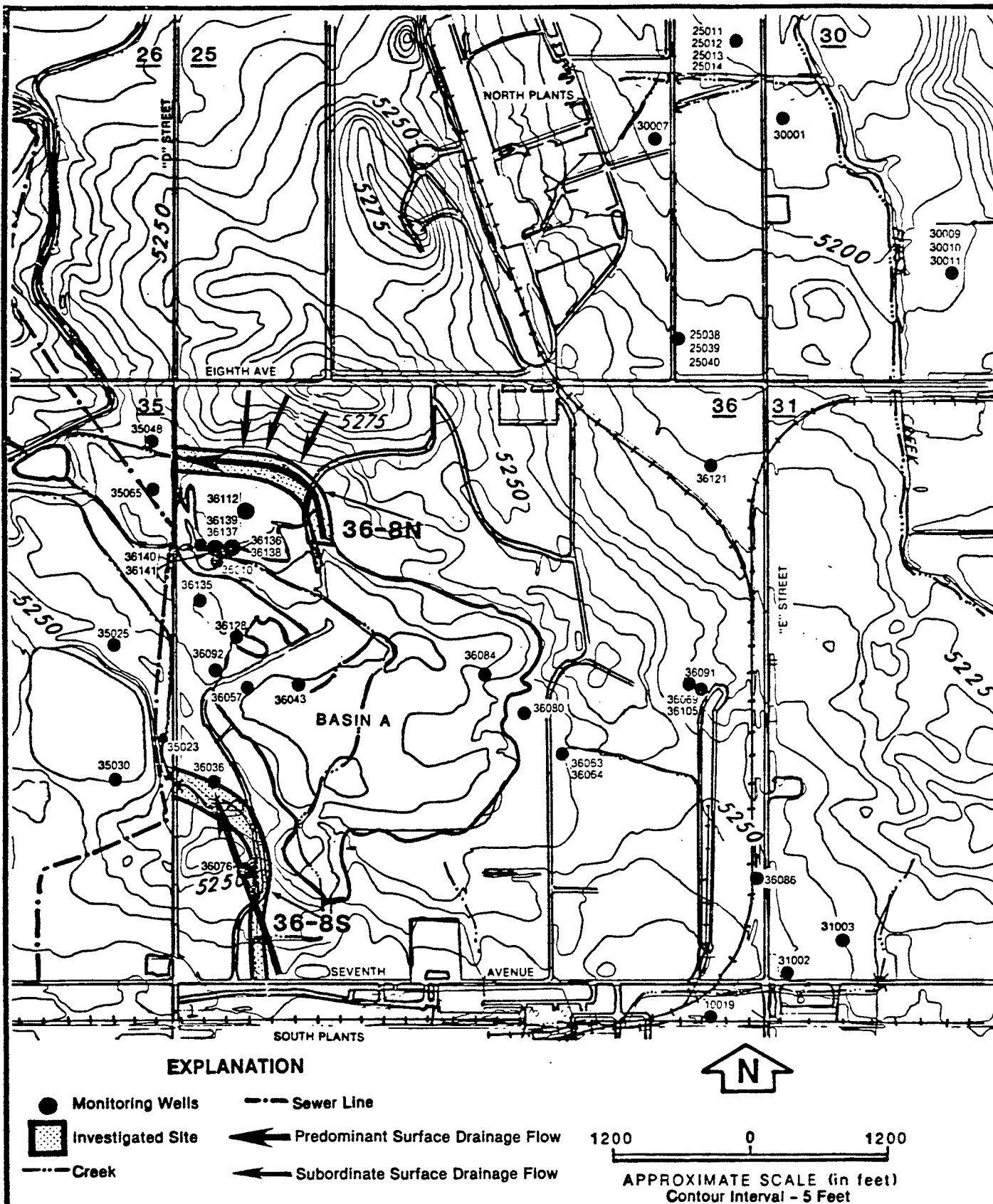
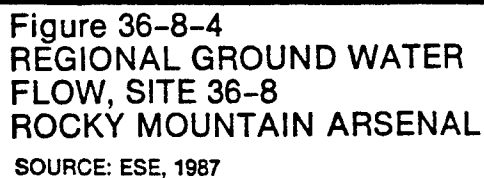


Figure 36-8-3  
REGIONAL TOPOGRAPHY  
SITE 36-8  
ROCKY MOUNTAIN ARSENAL

SOURCE: ESE, 1987

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Borings 3182 (36-8S) and 3184 (36-8N) encountered ground water at depths of 10 and 12.6 ft below ground surface. Using the top of the boring elevations and the above unstabilized water levels, the elevation of ground water was determined to be approximately 5,233 ft msl at 36-8S and 5,226 ft msl at Site 36-8N. This is in general agreement with the information presented in the Task 1 Technical Plan (ESE, 1985, RIC#85127R07) and the Task 4 data (ESE, 1986c, RIC#86238R08).

Previous investigations of the ground water in Section 36 near Site 36-8 took place during 1976 through 1985. The data generated from these investigations were retrieved from the USATHAMA RMA data base and reviewed. These data indicated sporadic detections of various target compounds such as arsenic, aldrin, endrin, dibromochloropropane (DBCP), diisopropylmethyl phosphonate (DIMP), dithiane, p-chlorophenylmethyl sulfone (CPMSO<sub>2</sub>), oxathiane, chloroform, and benzene.

Recent data generated by the Task 4 sampling program for Wells 36076, 36112, 36136, 36137, 36138, 36139, 36140, and 36141 (Figure 36-8-4), all downgradient of this site, show detections of many of the same target analytes (ESE, 1986c, RIC#86238R08). Although these compounds were detected in wells downgradient from Site 36-8, they represent a class of chemicals typically found in the ground water beneath the South Plants and Basin A. As a result, their presence in the ground water downgradient from the site does not imply that Site 36-8 is contributing to ground water contamination.

Additional information can be found in the Task 4 Initial Screening Program Report (ESE, 1986c, RIC#86238R08). These data are provided for background purposes and are not intended to be correlated with analytical results generated as part of the Phase I soils investigation.

## 2.0 HISTORY

Ditches 36-8S and 36-8N were reportedly used to transport fluids from Section 1 to a holding basin and from the north end of Basin A to Section 35, respectively. Ditch 36-8S eventually bypassed the holding basin and joined a ditch in Section 35 that continued north and west, ending in Section 34. This extension was constructed sometime between 1970 and 1975. A search of Shell I, Shell II, and Juris data bases did not produce any additional information on this site. The available aerial photographs (Stout et al., 1982, RIC#83368R01; HLA, 1986, RIC#86314P02) may be summarized as follows:

<u>Photograph Date</u>	<u>Description</u>
September 21, 1948	The northern ditch is visible and appears to drain fluid from Basin A into Section 35 and Basin B. The southern ditch is not visible.
July 21, 1950	Same as previous photograph.
1953, undated	Same as previous photograph.
February 21, 1958	Same as previous photograph.
August 11, 1962	The southern ditch is visible and appears to terminate in the southwest corner of Basin A. One of three Lime Settling Basins (Site 36-4) has been filled. The northern ditch remains unchanged.
October 15, 1964	More of the treatment basin area (Site 36-4) has been filled in, but some standing liquid is still present. The southern portion of the ditch is unchanged from previous photographs. The northern portion of the ditch has been filled in some sections. A new ditch constructed to the south appears to be draining fluids from Basin A into Section 35.
April 25, 1970	Unchanged from previous photograph.
October 15, 1975	The southern ditch can be seen from the northern edge of the Lime Settling Basins and continues north-northwest into an unnamed ditch in Section 35. The northern half of the site is unchanged.
September 20, 1980	No changes from the previous photograph.

### 3.0 SITE INVESTIGATION

#### 3.1 PREVIOUS SOIL INVESTIGATIONS

Site 36-8 consists of two open chemical drainage ditches which transect the northwest and southwest quarters of Section 36. Soil in this area belongs to the Ascalon-Vona-Truckton Association. This soil is defined as level to strongly sloping, well-drained loamy and sandy soil that becomes clay-rich and calcareous with depth (Sampson and Baber, 1974). No previous soil contamination studies are documented for this site.

#### 3.2 PHASE I SURVEY

##### 3.2.1 Phase I Program

The Phase I investigation at Site 36-8 consisted of drilling a total of 4 borings and obtaining 10 samples for chemical analysis. Borings ranged in depth from 5 to 11 ft. Boring locations are shown in Figures 36-8-5a and 36-8-5b. The site boundaries shown differ slightly from those presented in the Task 1 Technical Plan (ESE, 1985, RIC#85127R07) as a result of modifications made following field reconnaissance and aerial photograph interpretation. A borehole (3053) within the uncontaminated area (Site 36-UNC) located just north of Site 36-8N has been included in the assessment of this site (ESE, 1986b, RIC#87014R21A).

Prior to commencing drilling operations, all boring locations were cleared in accordance with the surface geophysics program detailed in the Task 1 Technical Plan (ESE, 1985, RIC#85127R07). Borehole site clearance (gradiometer geophysics) was used to ensure that drilling would not encounter buried unexploded ordnance (UXO) or other metal that could pose a significant safety risk. A 20-ft square grid was centered at each boring location and gradiometer readings were obtained at a spacing of 5 ft throughout the grid area. The contour map of the resulting data was used to place the boring in the safest location within the geophysical plot. Following borehole clearance with the gradiometer, a metal detector was used to check for surficial (0 to 2 ft) metal which may have presented a safety risk.



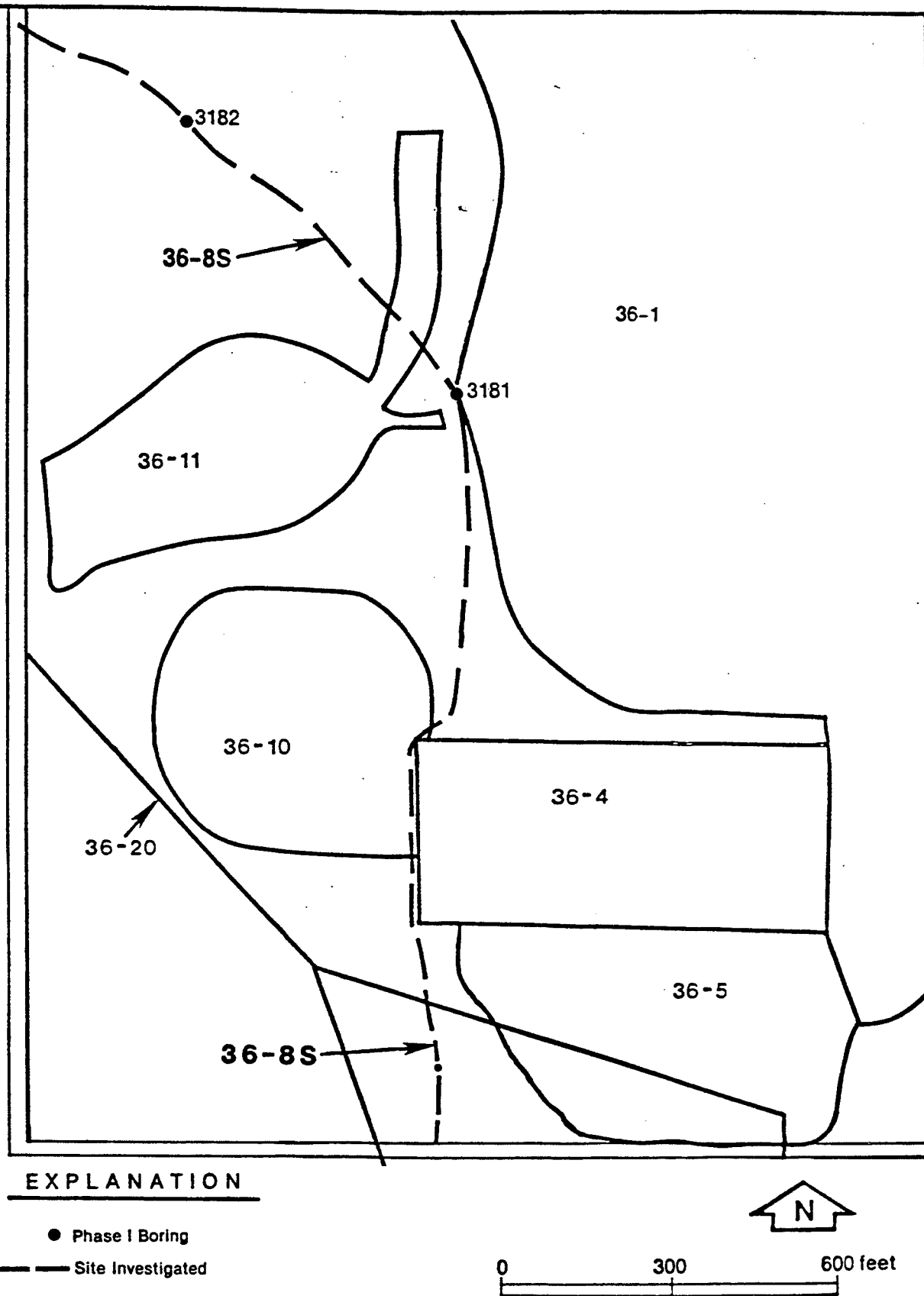


Figure 36-8-5a  
 SITE 36-8S, PHASE I INVESTIGATION  
 BORING LOCATION MAP

SOURCE: ESE, 1987

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 For Rocky Mountain Arsenal  
 Aberdeen Proving Ground, Maryland

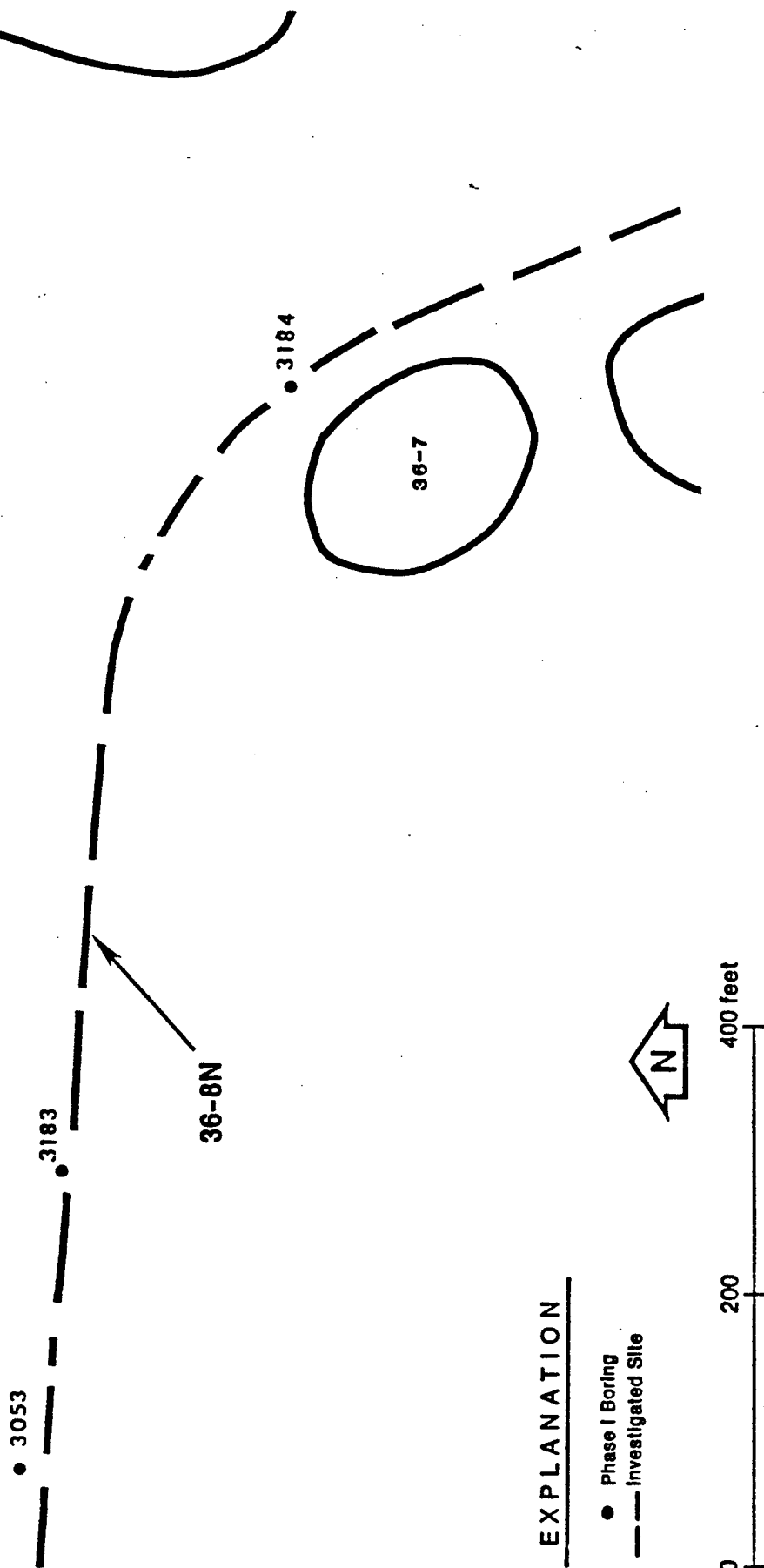


Figure 36-8-5b  
SITE 36-8N, PHASE I INVESTIGATION  
BORING LOCATION MAP

SOURCE: ESE, 1988

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Aberdeen Proving Ground, Maryland

Geophysical program results did not indicate the presence of any significant anomalies or buried metal at any borehole location in this site. Metal detector scans were negative at all locations. Borehole sites were selected on the basis of visual evidence, historical reports, aerial photographs, and to provide optimum coverage of the site. All borings for this site were located in the ditch to the extent that this was possible, to maximize the likelihood of locating any contamination.

A photoionization detector (PID), calibrated to an isobutylene standard, obtained readings from the open boreholes during drilling and from the samples during geologic logging. The PID measures the concentration of organic vapors in the air and is a method of ensuring personnel safety.

The sampling program at Site 36-8 collected 10 samples. All samples were obtained using the drill rig and continuous coring method as described in the Task 1 Technical Plan (ESE, 1985, RIC#85127R07). As explained therein, predetermined sampling intervals were established every 5 ft beginning with a 0 to 1 ft sample. In some cases field conditions, such as the water table position, required adjustment in these intervals.

Four borings yielding 10 samples were completed in Site 36-8 as follows:

<u>Boring No.</u>	<u>Depth (ft)</u>	<u>No. of Samples</u>
3181	5	2
3182	11	3
3183	5	2
3184	10	3

All samples were analyzed by gas chromatography/mass spectrometry (GC/MS) for semivolatile organic compounds and by inductively coupled-argon plasma (ICP) for cadmium, chromium, copper, lead, and zinc. Separate analyses were conducted for mercury and arsenic using atomic absorption (AA), and DBCP using GC/MS. GC/MS analyses for volatile organic compounds were performed on all samples except the 0- to 1-ft interval in each boring. Appendix 36-8-A presents the specific analytes for which laboratory analyses were conducted.

### 3.2.2 Phase I Field Observations

Air monitoring during drilling did not detect measurable levels of contaminants in the breathing zone. However, when the PID probe was inserted into the air space of the hollow stem auger, readings of 1 to 6 were observed. The highest reading was obtained from Boring 3181. This boring also revealed gray, lime cake materials at a depth of 1 to 4 ft.

Borings 3184 and 3181 encountered water at depths of 12.6 ft and 10 ft respectively. Boring 3184 was in the northern portion and Boring 3181 was in the southern portion of this site.

An M8 alarm and an M18A2 test kit were used to monitor the presence of chemical agents in boreholes and soil samples according to standard operating procedures. The M8 alarm is used specifically to detect sarin (GB) and nerve agent (VX) at detection levels of 0.2 and 0.4 milligrams per cubic meter ( $\text{mg}/\text{m}^3$ ) after a response time of 2 to 3 minutes (USAMDARC, 1982; USAMDARC, 1979). However, many other substances in addition to these two target compounds can cause the M8 alarm to respond, including smoke and engine exhaust. The M18A2 is used as a backup test if an M8 alarm is triggered, as a substitute for an M8, and as a specific check for the presence of mustard (H). The M18A2 test kit can detect a variety of chemical agents, including: G agents [tabun (GA), soman (GD), and GB]; VX agents; all forms of mustard [distilled mustard (HD), thickened mustard (HT), and nitrogen mustard (HN)]; cyanogen chloride (CK); phosgene oxime (CX); lewisite (L); ethyldichloroarsine (ED); and methyldichloroarsine (MD) (HDOA, 1976). The detection limit for mustard agents is  $0.5 \text{ mg}/\text{m}^3$ ; the detection limit for GB is  $0.2 \text{ mg}/\text{m}^3$ .

No chemical agents were detected at this site by the M8 or M18A2 monitoring. No unexploded ordnance, buried metal, or other objects were detected during drilling.

Samples taken from this site were also tested for the presence of chemical agents by the RMA laboratory. A composite of aliquots collected from each sample each day was initially analyzed for GB and mustard. If positive

readings were found, individual samples from each boring were analyzed to identify location. No positive findings for agents were encountered at this site.

### 3.2.3 Geophysical Exploration

No geophysical survey was performed at this site other than the borehole clearance program described in the Task 1 Technical Plan (ESE, 1985, RIC#85127R07). Historical data did not indicate disposal of any UXO, buried metal, or other objects at Site 36-8.

### 3.2.4 Phase I Analyte Levels and Distribution

A statistical summary of Phase I results is presented in Table 36-8-1. Samples containing detectable concentrations are presented in Table 36-8-2. Values within or above the indicator ranges are displayed in Figures 36-8-6a and 36-8-6b. Boring 3053, which was part of the 36-UNC program, was included on these figures due to its proximity to this site (ESE, 1986b, RIC#87014R21A).

To assess the significance of metal and organic analytical values, indicator ranges were established. For organic compounds, the indicator range is the method detection limit, whereas the indicator ranges for metals reflect the upper end of the normal range for each metal as naturally found in RMA alluvial soil. Selection of these ranges is discussed in the Introduction to the Contamination Assessment Reports (ESE, 1986a).

Because the southern ditch, 36-8S, drains the South Plants area, the anticipated contaminants included heavy metals and chlorinated pesticides. Borings 3181 and 3182 were drilled in this southern chemical drainage ditch. The northern ditch, 36-8N, appears to drain the northern end of Basin A, which may have contained burning and munitions disposal trenches. Borings 3183 and 3184 were drilled in this northern chemical drainage ditch. Analytical data for the Site 36-8 Phase I boring program are included in Appendix 36-8-B. A complete list of target compound chemical names and their abbreviations are in Appendix 36-8-A.

Table 36-0-1. Summary of Analytical Results for Site 36-0

Constituent	Number of Samples*	Range	Mean	Median	Concentrations (µg/g)			HPI Detection Limit	Indicator Range
					Standard Deviation	Detection Limit	ESZ		
<u>Volatiles (N=6)†</u>									
None Detected.									
<u>Semi-Volatiles (N=10)†</u>									
Dieldrin	4	0.3-2	--	--	--	0.3	0.3	0.6	DL
DHP	2	4-5	--	--	--	0.5	0.5	3.0	DL
<u>DICP (N=10)†</u>									
None Detected.									
<u>ICP Metals (N=10)†</u>									
None Detected.									
Cadmium	1	1.0	--	--	--	0.9	0.9	0.5	1.0-2.0
Chromium	8	8-20	12	11	3.6	7.2	7.4	7.4	25-40
Copper	10	5-15	8.4	7.5	3.1	4.8	4.9	4.9	20-35
Lead	4	17-30	--	--	--	17	16	16	25-40
Zinc	10	26-70	40	38	13	16	16	28	60-80
Arsenic (N=10)†	2	12-21	--	--	--	4.7	4.7	5.2	DL-10
Mercury (N=10)†	6	0.05-0.54	0.20	0.14	0.19	0.05	0.05	0.07	DL-0.10

<sup>a</sup> Number of samples in which constituent was detected above the detection limit.

† N = Number of samples analyzed.

-- Not calculated for less than five detections.

DL Detection limit.

Source: ESZ, 1987.

Table 36-8-2. Concentrations of Target Analytes Above Detection Limits in Site 36-8 Soil Samples

Bore Number	3181	3181	3182	3182	3182	3183	3184	3184	3184	3053**
Depth (ft)	0-1	4-5	0-1	0-1	4-5	0-1	0-1	4-5	9-10	Composite
Geologic Material	Silty Sand	Silty Sand	Silty Sand	Silty Sand	Silty Sand	Silty Sand	Silty Sand	Silty Sand	Slightly Silty Clay	(0-1/4-5) Silty Sand
<b>AIR MONITORING</b>										
PID <sup>a</sup>	BDL	6.0	BDL	NA	0.6	BDL	BDL	BDL	1.0	BDL
<b>SOIL CHEMISTRY</b>										
<b>Volatiles (pg/g)</b>										
<b>Semi-Volatiles (pg/g)</b>										
Dieldrin	BDL	2	BDL	BDL	BDL	0.4	BDL	BDL	BDL	0.4
DHP	BDL	BDL	BDL	BDL	BDL	BDL	BDL	5	4	0.8
<b>DCEP (pg/g)</b>										
None Detected										
<b>Metals (pg/g)</b>										
Cadmium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--
Chromium	8	11	11	14	12	BDL	13	20	10	9
Copper	5	15	6	9	6	7	10	9	11	6
Lead	BDL	30	BDL	BDL	BDL	29	17	BDL	17	--
Zinc	26	70	30	45	41	36	45	46	36	32
<b>Arsenic (pg/g)</b>										
	BDL	BDL	BDL	BDL	BDL	12	BDL	BDL	BDL	--
<b>Mercury (pg/g)</b>										
	BDL	0.54	0.05	0.05	BDL	0.29	0.06	BDL	BDL	0.06

<sup>a</sup> As calibrated to an isobutylene standard.

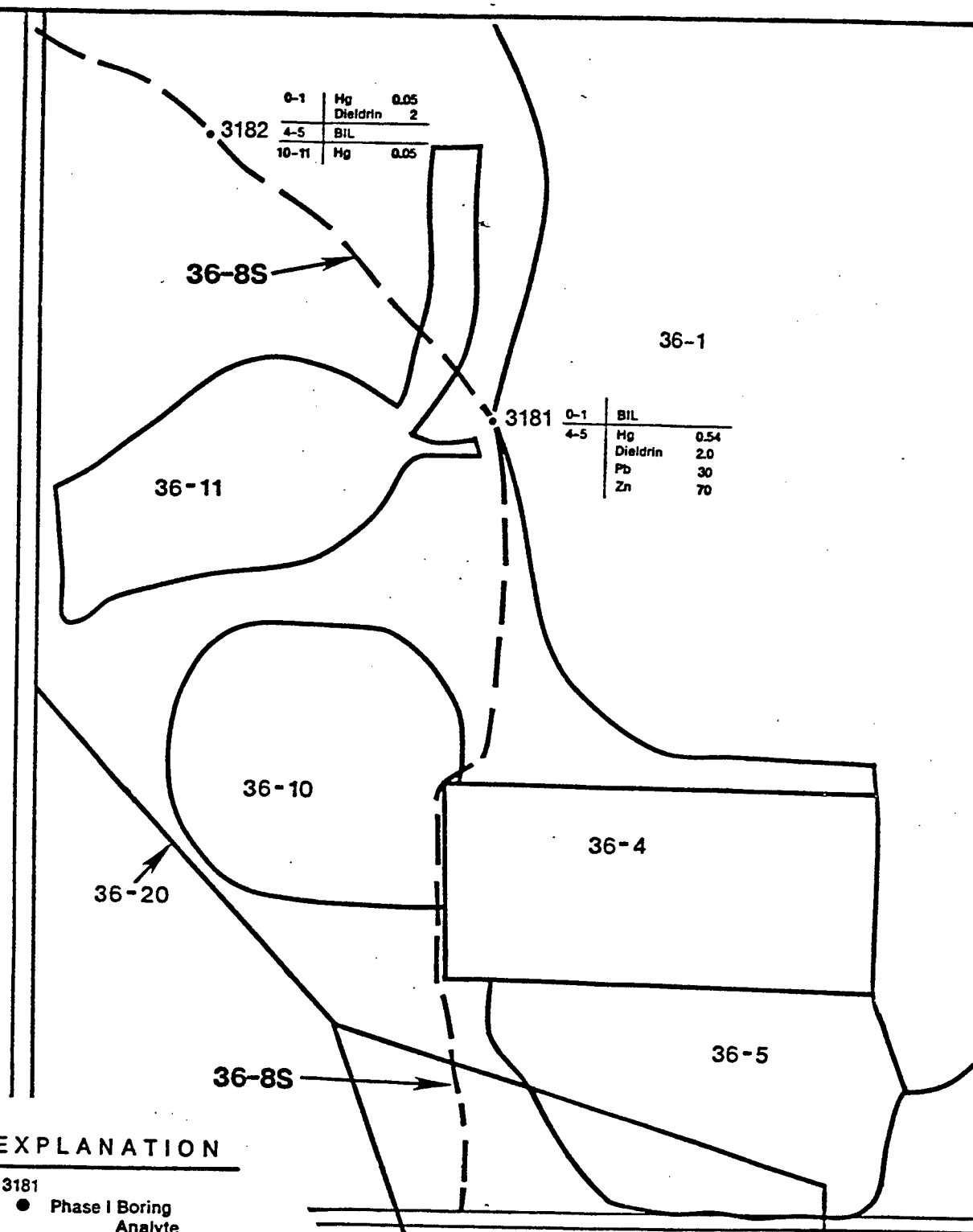
\*\* ESE, 1986a, RIC#8701AR21A

BDL No readings above ambient background.

BDL Below detection limit.

NA Not analyzed.

Source: ESE, 1987.



# EXPLANATION

3181		
● Phase I Boring		
Analyte		
Sampling Interval	0-1	Hg 0.05
	4-5	BIL
Level (ug/g)		
Sampling Interval	0-1	Hg 0.05
	4-5	BIL
9-10 Hg 0.05		
--- Site Investigated		

BIL No Organics Above Detection Limits;  
No Metals ≥ Indicator Range

Note: Semi-quantitative Analyses Converted to One Significant Figure.

0 300 600 feet

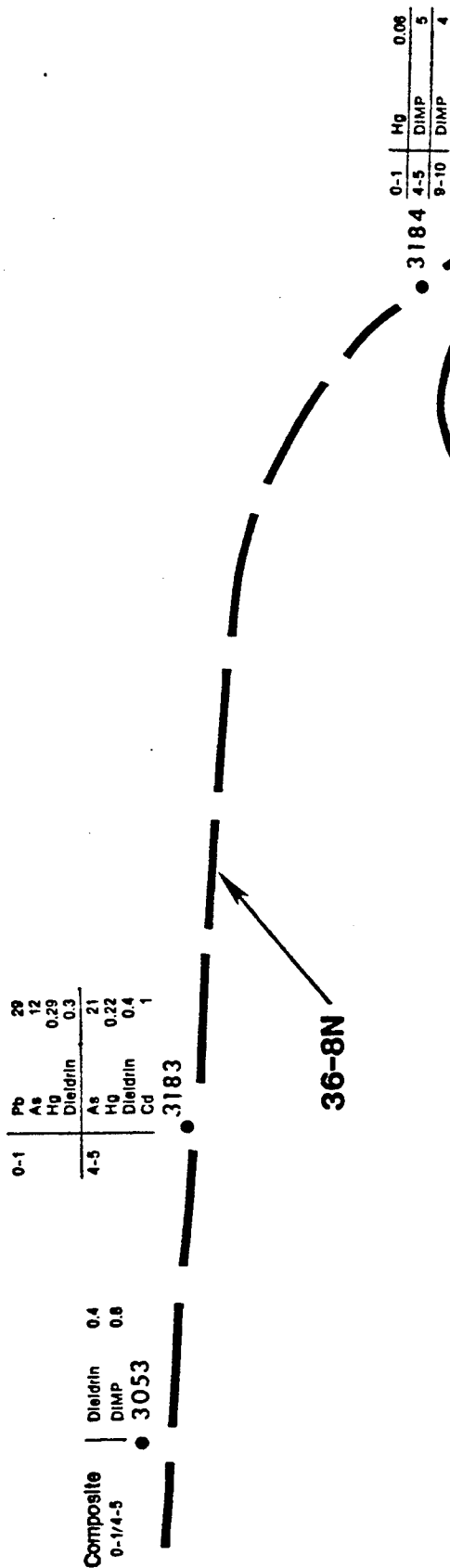


Figure 36-8-6a  
SITE 36-8S, PHASE I INVESTIGATION  
CHEMICAL ANALYSIS RESULTS

SOURCE: ESE, 1987

Prepared for:  
U.S. Army Program Manager's Office  
For Rocky Mountain Arsenal  
Aberdeen Proving Ground, Maryland





### EXPLANATION

3183 ● Phase I Boring  
 Analyte  
 — Site Investigated

Sampling Interval

0-1	Hg	0.06
4-5	DIMP	5
9-10	DIMP	4

Level (ug/g)

BIL No Organics Above Detection Limits;  
 No Metals ≥ Indicator Range

Note: Semi-quantitative Analyses Converted to One Significant Figure.

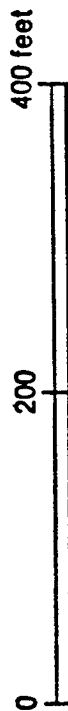


Figure 36-8-6b  
 SITE 36-8N, PHASE I INVESTIGATION  
 CHEMICAL ANALYSIS RESULTS

SOURCE: ESE, 1987

Prepared for:  
 U.S. Army Program Manager's Office  
 For Rocky Mountain Arsenal  
 Aberdeen Proving Ground, Maryland

One semivolatile compound, dieldrin, was detected at a concentration of 2 ppm in two samples from Ditch 36-8S (Boring 3182, 0 to 1 ft; Boring 3181, 4 to 5 ft). Target volatile organic compounds were not detected in any of the samples analyzed in the Phase I Program.

Mercury was detected within the indicator range at a concentration of 0.05 ppm in Boring 3182 in the 0 to 1 ft and 9 to 10 ft intervals. Mercury was found at a concentration (0.54 ppm) exceeding the indicator range in the 4 to 5 ft sample from Boring 3181. The 4 to 5 ft sample from Boring 3181 also had concentrations of lead and zinc within their respective indicator ranges.

Samples analyzed from the two borings in 36-8N revealed detections of metals as well as the semivolatile organic compounds, DIMP and dieldrin. Arsenic, mercury, and dieldrin were detected above their indicator ranges in the 0 to 1 ft and 4 to 5 ft intervals of Boring 3183. Lead was also detected in the 0 to 1 ft sample from Boring 3183 at a concentration of 29 ppm. Cadmium occurred in the 4 to 5 ft interval of Boring 3183 at a concentration of 1 ppm. Both concentrations of these compounds were within their indicator ranges. Boring 3184 (0 to 1 ft) revealed mercury at a concentration of 0.06 ppm which is within the indicator range. The 4 to 5 and 9 to 10 ft intervals of this boring also had DIMP concentrations of 5 ppm and 4 ppm, respectively.

Because of its proximity to Site 36-8N, Boring 3053 (Site 36-UNC) was included as part of the Site 36-8 contamination assessment (ESE, 1986b, RIC#87014R21A). Dieldrin and DIMP were detected in Boring 3053 at concentrations of 0.4 and 0.8 ppm, respectively. Because this boring was from a uncontaminated area, a sample was composited from the 0 to 1 and 4 to 5 ft intervals.

Compounds which were not part of the target list (nontarget compounds) detected during the Phase I GC/MS analysis are included in the data presented in Appendix 36-8-B. Each nontarget compound is identified by a three digit number indicative of its relative retention time. Library

searches were run against the nontarget compounds and tentative identifications were made as summarized in Table 36-8-3. It should be noted that an individual compound may have more than one retention time, and that a particular retention time may be assigned to more than one compound. Table 36-8-3 provides only a general indication of additional compounds that may be present.

Nontarget compounds were found in five of the nine samples collected as part of the Site 36-8 Phase I Program. Most compounds present were identified as naturally-derived products. Although pentachloro (trichloroethenyl) benzene was tentatively identified in the 0 to 1 ft interval of Boring 3181, the concentration (0.5 ppm) was too low for a positive identification.

### 3.2.5 Phase I Contamination Assessment

Samples from Ditch 36-8S contained detectable concentrations of dieldrin, as well as mercury concentrations above the indicator range. Dieldrin was detected in the 0 to 1 ft sampling interval of Boring 3182. Dieldrin and mercury were observed in the 4 to 5 ft interval of Boring 3181. This boring may have been influenced by materials from Basin A (Site 36-1) or the Lime Settling Pits (Site 36-4). Concentrations of lead and zinc in the 4 to 5 ft sample from Boring 3181 were within their respective indicator ranges. On the basis of the absence of any disposal history for these two analytes at this site, these levels are thought to be within the range of concentrations that occur naturally in alluvial materials at RMA.

Samples from Ditch 36-8N contained detectable concentrations of DIMP and dieldrin, as well as mercury and arsenic at concentrations above the indicator range. Dieldrin, arsenic, and mercury were observed in the 0 to 1 ft and 4 to 5 ft samples from Boring 3183. DIMP was detected in the 4 to 5 ft and 9 to 10 ft intervals of Boring 3184. In addition, dieldrin and DIMP were detected in Boring 3053 which is approximately 20 ft north of the northwestern end of Ditch 36-8N. The detections of these compounds may be indicative of liquids disposed of in Basin A (Site 36-1) and subsequently transported by Ditch 36-8N to Basin B (Site 35-3).

Table 36-8-3. Tentative Identification of Montarget Compounds

Borehole Number	Interval Depth (ft)	Unknown Number	Concentration Above Background (ppm)*	Sample Number	Lot	Best Fit	Comment†
3181	0-1	614	0.5	509700	BAP	pentachloro (trichloroethenyl) benzene	f
	4-5						j
3182	0-1	614	0.7	509857	BAP	9-octadecen-1-ol	j
	4-5						d
	10-11						j
3183	0-1	614	7	509812	BAT	9-octadecen-1-ol	d
	4-5	631	0.9	509813	BAT	dioctyladipate	c,d,f
3184	0-1	614	0.9	509819	BAR	9-octadecen-1-ol	j
	4-5						d
3053**	0-1	518	0.2	498653	BAF	Tetrachloroethylene	e,f
		598	2		BAF	Dodecanoic acid	d
		608	5		BAF	Pentadecanoic acid	d
		609	9		BAF	Hexadecanoic acid	d
		636	1		BAF	Dicetyl phthalate	c, f, g, h

\* Values reported are blank corrected.

\*\* ESE, 1986b, RIC #8701A21A

† No positive identification.

a. Surfactant.

b. Plasticizer (note: All phthalates and adipates will have this comment.)

c. Derived from natural products.

d. Suspected laboratory contaminant.

e. Low concentration.

f. Low frequency of occurrence.

g. Ubiquitous.

h. Possible column bleed.

i. None detected.

j. None detected.

Source: ESE, 1987.

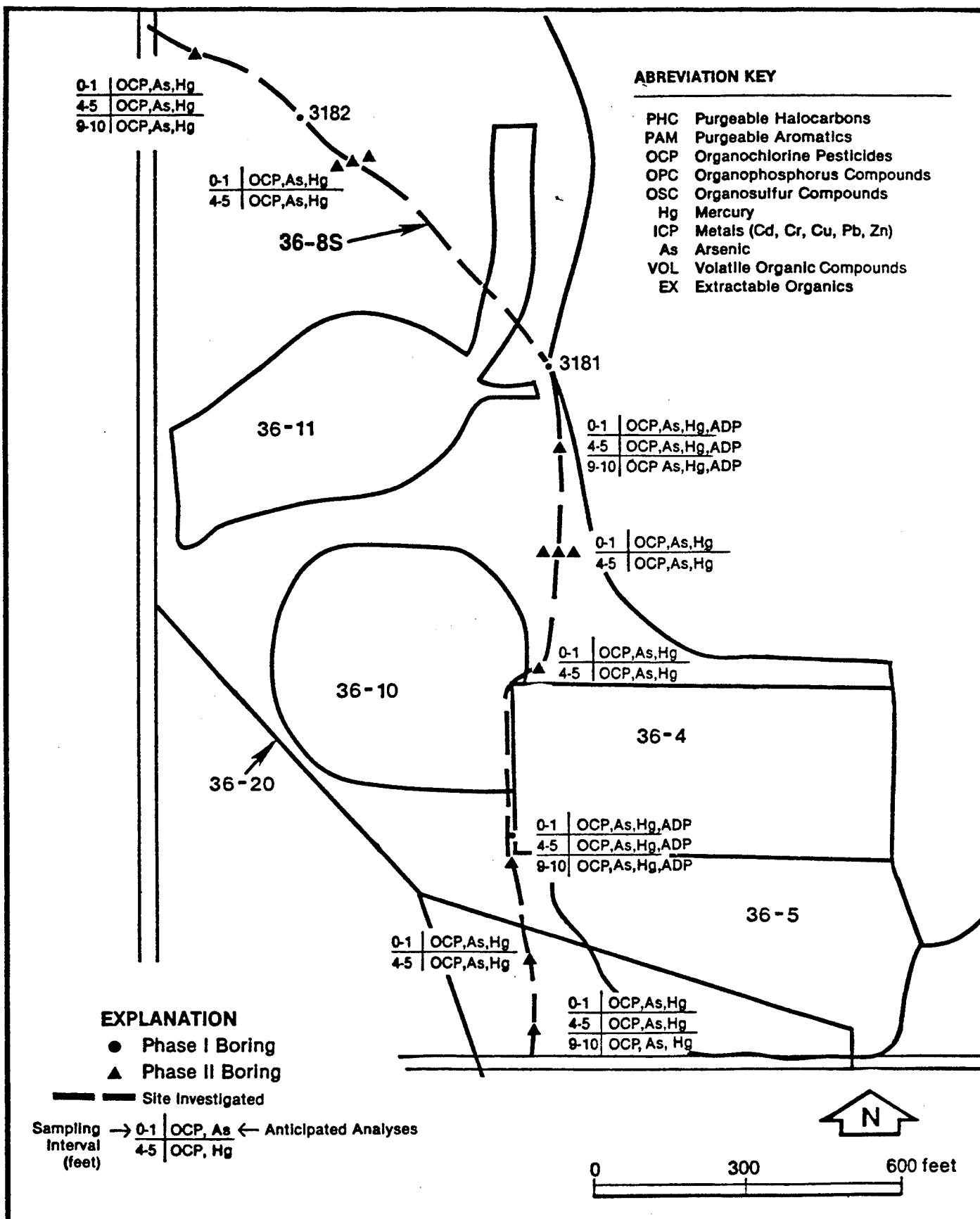
The semivolatile GC/MS method applied to all Phase I samples, although not certified for volatile compounds, has been shown capable of detecting tetrachloroethylene, toluene, chlorobenzene, ethylbenzene, and xylenes in the nontarget fraction. The absence of these compounds in the nontarget results for Site 36-8 is an indication that no contamination is present from these compounds.

### 3.3 PHASE II SURVEY

An evaluation of Phase I analytical data and a review of aerial photographs and topographic maps indicate that the boundaries for Site 36-8 do not require modification. However, to determine the lateral extent of possible contamination that could have resulted from the use of these chemical drainage ditches, a width of 50 ft will be investigated in Phase II. Phase II borings will be located within 25 ft of the centerline of each drainage ditch. Three or five borings will be drilled 10 to 25 ft from the center line in a transect perpendicular to each ditch at several locations. These borings will evaluate the lateral dispersion of compounds. Transects consisting of five borings will be drilled in the northern section where earth moving has taken place and the exact ditch alignment is difficult to define. Proposed boring locations and the sampling plan are shown on Figures 36-8-7a and 36-8-7b.

The Phase II sampling plan will consist of a total of 25 borings. Thirteen borings will be drilled along 36-8N and 12 borings will be drilled along 36-8S. A total of six borings will penetrate to the water table. Sampling intervals for Phase II borings will be 0 to 1 ft, 4 to 5 ft, 9 to 10 ft, and 14 to 15 ft. These intervals will be adjusted in the field to ensure that a sample is taken at the same level as the bottom of the ditch. On the basis of the Phase I water table elevations, the total number of samples to be collected in the 25 Phase II boreholes are as follows:

<u>Number of Borings</u>	<u>Depth (ft)</u>	<u>Number of Samples</u>
4	10 (Water Table)	12
2	15 (Water Table)	8
<u>19</u>	5	<u>38</u>
TOTAL 25		58



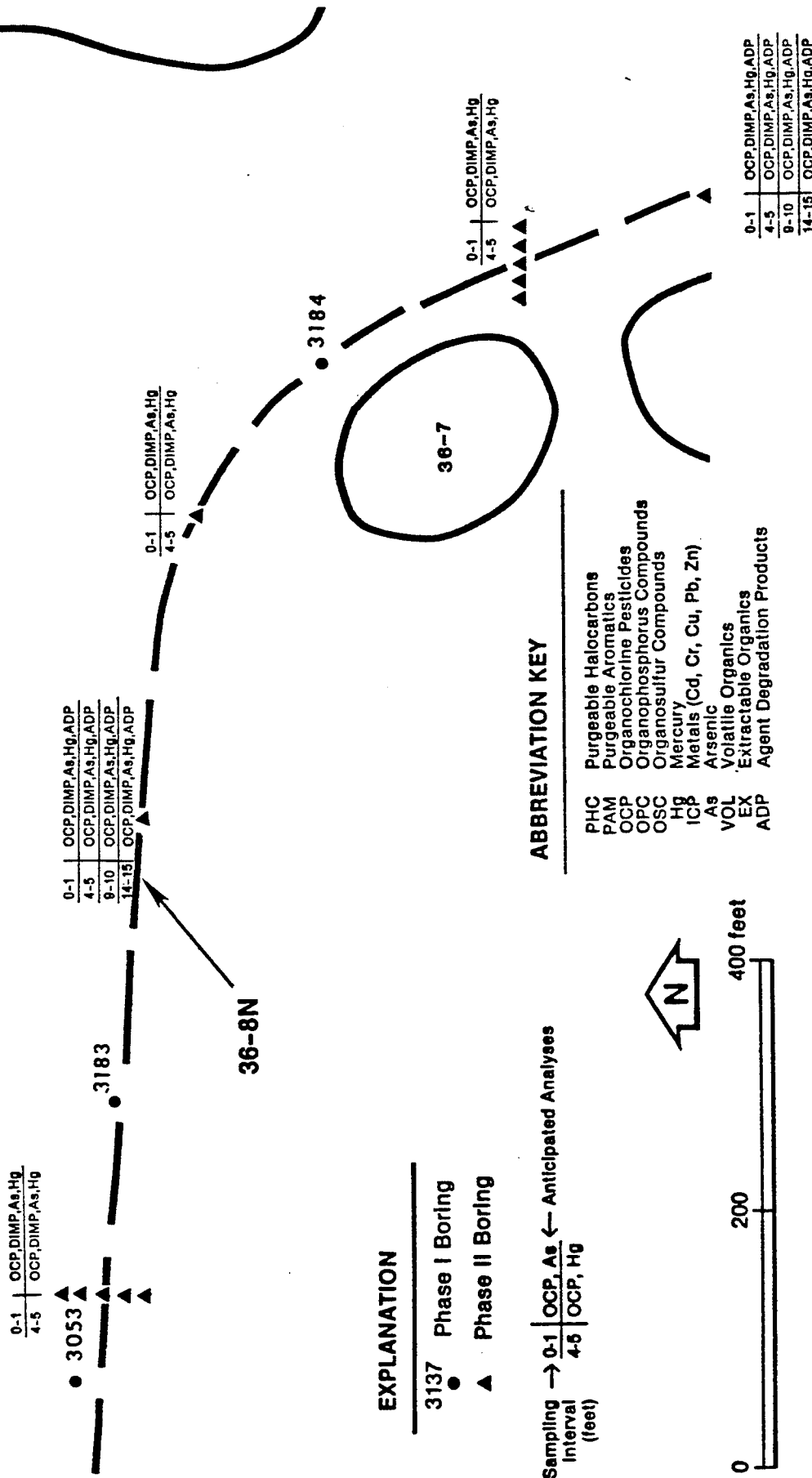


Figure 36-8-7b  
SITE 36-8N, PROPOSED  
PHASE II INVESTIGATION

SOURCE: ESE, 1986

Prepared for:  
U.S. Army Program Manager's Office  
For Rocky Mountain Arsenal  
Aberdeen Proving Ground, Maryland

The analytical schedule for the Phase II program at Site 36-8 is summarized below:

<u>Analytical Method</u>	<u>Number of Samples</u>
Organochlorine pesticides	58
Arsenic	58
Mercury	58
DIMP	30
Agent Degradation Products (ADP)	14

All samples will be analyzed for organochlorine pesticides. Because elevated concentrations of arsenic and mercury were found in the 0 to 1 ft and 4 to 5 ft samples and are widespread throughout Section 36, all Phase II samples will be tested for these elements to verify their occurrence and to supplement the regional investigation for arsenic. As DIMP was only detected in samples taken from the 36-8N ditch, only these samples will be analyzed for DIMP. Specific analyses for Army Agent Degradation Products (ADP) will be conducted on selected samples as shown in Figures 36-8-7a and 36-8-7b.

The low concentration of pentachloro (trichloroethenyl) benzene was not deemed significant for further study at this time. The occurrence of this compound will be reviewed after all Phase II data have been reevaluated.

The Site 36-8 Draft Report and the proposed Phase II program were reviewed at the onpost MOA meeting on June 3 and 4, 1986. Comments were received from the Colorado Department of Health (CDH) on May 21, 1986, and from Shell Chemical Company (SCC) on April 7, 1986. These comments were considered in the preparation of this final report and are presented with responses in Appendix 36-8-C. U.S. Environmental Protection Agency comments are an integral part of the report review process and have been previously incorporated into this report.



### 3.4 QUANTITY OF POTENTIALLY CONTAMINATED SOIL

The previous estimate of potentially contaminated soil at this site was 8,000 yd<sup>3</sup> (RMACCPMT, 1984, RIC#84034R01). This estimate included an areal extent of 22,200 ft<sup>2</sup> and a possible vertical extent of 10 ft.

After completion of the Phase I investigation it appears that the areal extent should be increased to 36,000 ft<sup>2</sup> and the depth decreased to 9 ft. The areal extent assumes 3,600 linear ft of ditch and a ditch width of 10 ft. Thus, the revised estimate yields a total of 12,000 yd<sup>3</sup> of material that is potentially contaminated. This volume may be further revised pending completion of the Phase II investigation.

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APPENDIX 36-8-A  
CHEMICAL NAMES AND ABBREVIATIONS

# APPENDIX 36-8-A CHEMICAL NAMES AND ABBREVIATIONS

All 10 soil samples collected during the Phase I boring program were analyzed for semivolatile organic compounds, ICP metals, arsenic, mercury, and DECP. Six of these samples were also analyzed for volatile organic compounds. The Phase I analytes are listed below:

<u>Analytes</u>	<u>Synonymous Names Used in Appendix B</u>	<u>Abbreviations</u>
<b>Volatile Organics</b>		
Trans 1,2-dichloroethene	Trans 1,2-dichloroethene	T12DCE
Ethylbenzene	Ethylbenzene	ETCC <sub>6</sub> H <sub>5</sub>
Methylene chloride	Methylene chloride	CH <sub>2</sub> CL <sub>2</sub>
Tetrachloroethene (PCE)	Tetrachloroethene	TCLEE
Toluene	Toluene	MEC <sub>6</sub> H <sub>5</sub>
1,1,1-Trichloroethane (TCA)	1,1,1-Trichloroethane	111TCE
1,1,2-Trichloroethane	1,1,2-Trichloroethane	112TCE
Trichloroethene (TCE)	Trichloroethene	TRCLE
m-Xylene	m-Xylene	XYLEN
Methylisobutyl ketone	MIBK	MIBK
Dimethyldisulfide	DMDS	DMDS
Benzene	Benzene	C <sub>6</sub> H <sub>6</sub>
o,p-Xylene	o- and/or p-Xylene	XYLEN
Carbon tetrachloride	Carbon tetrachloride	CCL <sub>4</sub>
Chlorobenzene	Chlorobenzene	CLC <sub>6</sub> H <sub>5</sub>
Chloroform	Chloroform	CHCL <sub>3</sub>
1,1-Dichloroethane	1,1-Dichloroethane	11DCLE
1,2-Dichloroethane	1,2-Dichloroethane	12DCLE
Bicycloheptadiene	Bicycloheptadiene	BCHD
<b>Semivolatile Organics</b>		
Aldrin	Aldrin	ALDRN
Endrin	Endrin	ENDRN
Dieldrin	Dieldrin	DLDRN
Isodrin	Isodrin	ISODR
p,p'-DDT	Dichlorodiphenyltrichloroethane	PPDDT
p,p'-DDE	Dichlorodiphenylethane	PPDDE
Hexachlorocyclopentadiene	Hexachlorocyclopentadiene	CL <sub>6</sub> CP
1,4-Oxathiane	1,4-Oxathiane	OXAT
Dithiane	Dithiane	DITH
Malathion	Malathion	MLTHN
Parathion	Parathion	PRTHN
Chlordane	Chlordane	CLDAN
Supona	2-Chloro-1(2,4-dichlorophenyl) vinyl diethyl phosphate	SUPONA
Diisopropylmethyl phosphonate	Diisopropylmethyl phosphonate	DIMP
Dimethylmethyl phosphonate	Dimethylmethyl phosphonate	DMMP
Atrazine	Atrazine	ATZ
Dicyclopentadiene	Dicyclopentadiene	DCPD
Vapona	Vapona	DDVP

APPENDIX 36-8-A  
CHEMICAL NAMES AND ABBREVIATIONS

<u>Analytes</u>	<u>Synonymous Names Used in Appendix B</u>	<u>Abbreviations</u>
Semivolatile Organics (Cont)		
Chlorophenylmethyl sulfide	p-Chlorophenylmethyl sulfide	CPMS
Chlorophenylmethyl sulfoxide	p-Chlorophenylmethyl sulfoxide	CPMSO
Chlorophenylmethyl sulfone	p-Chlorophenylmethyl sulfone	CPMSO <sub>2</sub>
Dibromochloropropane	Dibromochloropropane	DBCP
ICP Metals Screen		
Chromium	Chromium	CR
Zinc	Zinc	ZN
Cadmium	Cadmium	CD
Copper	Copper	CU
Lead	Lead	PB
Separate Analyses		
Arsenic	Arsenic	AS
Mercury	Mercury	HG
Dibromochloropropane	Dibromochloropropane	DBCP

APPENDIX 36-8-B  
PHASE I CHEMICAL DATA

PROJECT NUMBER 84936 0300 SECTION 36 RMA  
 FIELD GROUP 36 BA PROJECT MANAGER BILL FRASER  
 5098S LAB COORDINATOR PAUL GEISZLER

PARAMETERS	UNITS	STORET #	METHOD	3181A	3181B	3182A	3182B	3182C	3183A	3183B	3184A	3184B	3184C	BLANK	BLANK	BLK
DATE				05/15/85	05/15/85	05/15/85	05/15/85	05/15/85	05/23/85	05/23/85	05/16/85	05/16/85	05/16/85	05/15/85	05/16/85	05/23/85
TIME				15:50	16:07	14:52	15:01	15:25	10:42	10:53	08:01	08:07	08:25	00:00	00:00	00:00
SAMPLE TYPE			71999	SO	SO	SO	SO	SO	SO	SO	SO	SO	SO	SO	SO	SO
SAMPLE DEPTH			99758A	0.0	4.00	0.0	4.00	10.0	0.0	4.00	0.0	4.00	9.00	0.0	0.0	0.0
FT			0													
SITE TYPE I			99759	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	QCHB	QCHB	QCHB
INSTALLATION CODE			0													
SAMPLE			99720	RK	RK	RK	RK	RK	RK	RK	RK	RK	RK	RK	RK	RK
SAMPLING TECHNIQUE			72005	S	S	S	S	S	S	S	S	S	S	G	G	G
COORDINATE N/S			0													
STP			98392	181838	181838	182265	182265	182265	185173	185173	184966	184966	184966	NA	NA	NA
COORDINATE E/W			0													
STP			98393	2184317	2184317	2183850	2183850	2183850	2183963	2183963	2184710	2184710	2184710	NA	NA	NA
MOISTURE			70320	7.7	8.4	5.9	7.6	19.3	6.0	5.9	8.7	9.9	17.3	2.1	2.1	2.3
WET WT			0	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900	1.00	<0.900	<0.900	<0.900	NA	NA	NA
CADMIUM			1028	8.00	11.0	11.0	12.0	14.0	<7.00	<7.00	13.0	20.0	10.0	NA	NA	NA
UC/G- DRY			0													
CHROMIUM			99584	5.00	15.0	6.00	6.00	9.00	7.00	6.00	10.0	9.00	11.0	NA	NA	NA
UC/G- DRY			0													
COPPER			1043	<17.0	30.0	<17.0	<17.0	<17.0	29.0	<17.0	17.0	<17.0	17.0	NA	NA	NA
UC/G- DRY			0													
LEAD			1052	26.0	70.0	30.0	41.0	45.0	36.0	29.0	45.0	46.0	36.0	NA	NA	NA
UC/G- DRY			0													
ZINC			1093	<4.70	<4.70	<4.70	<4.70	<4.70	12.0	21.0	<4.70	<4.70	<4.70	NA	NA	NA
UC/G- DRY			0													
ARSENIC			1003	<0.050	0.540	0.050	<0.050	0.050	0.290	0.220	0.060	<0.050	<0.050	NA	NA	NA
UC/G- DRY			0													
MERCURY			71921-	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900	NA	NA	NA
UC/G- DRY			0													
ALDRIN			98356	<0.300	1.89	2.05	<0.300	<0.300	0.324	0.432	<0.300	<0.300	<0.300	NA	NA	NA
UC/G- DRY			0													
DIELDRIN			98365	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	NA	NA	NA
UC/G- DRY			0													
DDT, PP*			98364	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	NA	NA	NA
UC/G- DRY			0													
ENDRIN			98369	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NA	NA	NA
UC/G- DRY.			0													
CHLORDANE			98361	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NA	NA	NA
UC/G- DRY			0													



PROJECT NUMBER 84936 0300  
FIELD GROUP 36 8A  
5098S

PROJECT NAME SECTION 36 RHA  
PROJECT MANAGER BILL FRASER  
LAB COORDINATOR PAUL GETSZLER

PARAMETERS	UNITS	STORET #	METHOD	3181A	3181B	3182A	3182B	3182C	3183A	3183B	3184A	3184B	3184C	BLANK	BLANK	BLA
DATE				05/15/85	05/15/85	05/15/85	05/15/85	05/15/85	05/23/85	05/23/85	05/16/85	05/16/85	05/16/85	05/16/85	05/23/85	
TIME				15:50	16:07	14:52	15:01	15:25	10:42	10:53	08:01	08:07	08:25	00:00	00:00	00:00
DDE, PP'		98363		<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	NA	NA
UG/G-DRY		0														
1,4 OXATHIANE		98644		<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	NA	NA
UG/G-DRY		0														
DIMP		98645		<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	5.49	3.63	<0.500	NA	NA
UG/G-DRY		0														
VAPONA		98646		<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	NA	NA
UG/G-DRY		0														
HEXACHLOROCYCLOPENTADIENE		98647		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NA	NA
UG/G-DRY		0														
ADIBENE		98648		<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	NA	NA
UG/G-DRY		0														
MALATHION		98649		<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	NA	NA
UG/G-DRY		0														
ISODIN		98650		<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	NA	NA
UG/G-DRY		0														
1,4 DITHIANE		98651		<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	NA	NA
UG/G-DRY		0														
DICYCLOPENTADIENE		98652		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA	NA
UG/G-DRY		0														
DBCP (NEMAGON)		98653		<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	NA	NA
UG/G-DRY		0														
P-CLIPHENYL METHYL -		98654		<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	NA	NA
UG/G-DRY		0														
SULFIDE		98655		<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	NA	NA
UG/G-DRY		0														
SULFOXIDE		98656		<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	NA	NA
UG/G-DRY		0														
ATRAZINE		98657		<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	NA	NA
UG/G-DRY		0														
SUPONA		98658		<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	NA	NA
UG/G-DRY		0														
DMMP		98703		<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	NA	NA
UG/G-DRY		0														
PARATHION		98687		NA	<0.500	NA	<0.500	<0.500	NA	<0.300	NA	<0.500	<0.500	<0.500	NA	NA
UG/G-DRY		0														
P-CLIPHENYL METHYL -		98688		<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	NA	NA
UG/G-DRY		0														
SULFONE		98689		NA	<0.500	NA	<0.500	<0.500	NA	<0.300	NA	<0.500	<0.500	<0.500	NA	NA
UG/G-DRY		0														
TRANS-1,2-DICHLOROETHENE		98689		NA	<0.500	NA	<0.500	<0.500	NA	<0.300	NA	<0.500	<0.500	<0.500	NA	NA
UG/G-DRY		0														
ETHYLENE		98689		NA	<0.500	NA	<0.500	<0.500	NA	<0.300	NA	<0.500	<0.500	<0.500	NA	NA
UG/G-DRY		0														
ETHYLBENZENE		98689		NA	<0.500	NA	<0.500	<0.500	NA	<0.300	NA	<0.500	<0.500	<0.500	NA	NA
UG/G-DRY		0														
METHYLENE CHLORIDE		98689		NA	<0.500	NA	<0.500	<0.500	NA	<0.300	NA	<0.500	<0.500	<0.500	NA	NA
UG/G-DRY		0														



# ENVIRONMENTAL SCIENCE & ENGINEERING

11/14/85

STATUS: PRELIMINARY

PROJECT NUMBER 84916300  
FIELD GROUP: UNCL\*  
PARAMETERS: ALL SAMPLES: ALL

PROJECT NAME SECTION 36 RMA  
PROJECT MANAGER: BILL FRASER  
FIELD GROUP LEADER: GEISLER/BERGDOLL

SAMPLE NUMBERS

PARAMETERS	STORET #	METHOD #
DATE	3053	04/29/85
TIME	498653	1509
SAMPLE TYPE	71999	SG
SAMPLE DEPTH	99758	0
SITE TYPE 1	99759	BORE
INSTALLATION CODE	99720	RK
SAMPLING TECHNIQUE	72005	S
MOISTURE(ZNET WT)	10320	8.0
CADMIUM,SED (UG/G-DRY)	1028	<0.9
CR,SOIL (UG/G-DRY)	99584	9
COPPER,SED (UG/G-DRY)	1043	6
LEAD,SED (UG/G-DRY)	1052	<17
ZINC,SED (UG/G-DRY)	1093	32
ARSENIC,SED (UG/G-DRY)	1003	<4.7
MERCURY,SED (UG/G-DRY)	71921	0.06
ALDRIN,SED (UG/G-DRY)	78356	<0.900
DIELDRIN(UG/G-DRY)	93363	0.442
DDT,PP* (UG/G-DRY)	93364	<0.400
ENDRIN (UG/G-DRY)	98369	<0.700
CHLORDANE,SED(UG/G-DRY)	93361	<1.00
DDE,PP*(UG/G-DRY)	98363	<0.300
1,4 OXATHIANE (UG/G-DRY)	98644	<0.300

\*Source: ESE, 1986, RIC #87014R21A

# ENVIRONMENTAL SCIENCE & ENGINEERING

PROJECT NUMBER 84936300  
FIELD GROUP: UNCL\*  
PARAMETERS: ALL SAMPLES: ALL

11/14/85

STATUS: PRELIMINARY

PROJECT NAME SECTION 36 RMA  
PROJECT MANAGER: BILL FRASER  
FIELD GROUP LEADER: GEISZLER/BERGDOLL

SAMPLE NUMBERS

PARAMETERS	STORE #	3053 498653
DATE	METHOD #	04/29/85
TIME		1509
DIMP (UG/G-DRY)	93642	0.769
DICHLORVES (UG/G-DRY)	93646	<0.300
HEXCLCYFLOI (UG/G-DRY)	93647	<1.00
MALATHION (UG/G-DRY)	93648	<0.600
ISODRIN (UG/G-DRY)	93649	<0.300
1,4 DITHIANE (UG/G-DRY)	93650	<0.300
DICYCLOPENTADIENE (UG/G-DRY)	93651	<0.300
OBCP(MENAGON) (UG/G-DRY)	93652	<0.005
P-CLPHENTHETHYSULFI	93653	<0.300
DL(UG/G-DRY)	93654	<0.400
P-CLPHENTHETHYSULFO	93655	<0.700
NL(UG/G-DRY)	93656	<0.500
ATRAZINE (UG/G-DRY)	93657	<2.00
SUPONA (UG/G-DRY)	93658	<0.700
DMHP (UG/G-DRY)	93659	<0.300
EITYPARATHION (UG/G-DRY)	93660	185216
PCPHSD2 (UG/G-DRY)	93661	2183690
COORDINATE N/S(STP)	93662	
COORDINATE E/W(STP)	93663	
UNK517 (UG/G)	90012	
UNK523 (UG/G)	90092	
UNK609 (UG/G)	90066	A 8.56

\*Source : ESE, 1986, RIC #87014R21A

# ENVIRONMENTAL SCIENCE & ENGINEERING

PROJECT NUMBER 94V3630G  
FIELD GROUP: UNCL\*  
PARAMETERS: ALL SAMPLES: ALL

11/14/85

STATUS: PRELIMINARY

PROJECT NAME SECTION 36 RMA  
PROJECT MANAGER: BILL FRASER  
FIELD GROUP LEADER: GEISLER/BERGDOLL

## SAMPLE NUMBERS

PARAMETERS	SAMPLE #	DATE	TIME
UNK527 (UG/G)	90017	3053	
UNK614 (UG/G)	90070	490653	
UNK619 (UG/G)	90105		
UNK630 (UG/G)	90106	04/29/85	1509
UNK532 (UG/G)	90020		
UNK620 (UG/G)	90074		
UNK625 (UG/G)	90078		
UNK627 (UG/G)	90080		
UNK638 (UG/G)	90090		
UNK519 (UG/G)	90091		
UNK629 (UG/G)	90082		
UNK636 (UG/G)	90088		
UNK558 (UG/G)	90098		
UNK559 (UG/G)	90099		
UNK652 (UG/G)	90111		
UNK588 (UG/G)	90049		
UNK633 (UG/G)	90085		
UNK535 (UG/G)	90093		
UNK542 (UG/G)	90024		
UNK608 (UG/G)	90065		

\* 1.34

\* 4.87

\* Source ESE, 1986, RIC#87014R21A

# ENVIRONMENTAL SCIENCE & ENGINEERING

11/14/85

STATUS: PRELIMINARY

PROJECT NUMBER: 84936300

FIELD GROUP: GR1\*

PARAMETERS: ALL SAMPLES: ALL

PROJECT NAME: SECTION 36 RMA  
PROJECT MANAGER: BILL FRASER  
FIELD GROUP LEADER: GEISLER/BERGOLL

SAMPLE NUMBERS

PARAMETERS	STORE #	DATE	TIME
UNK635 (UG/G)	90087	04/29/85	1509
UNK518 (UG/G)	90013		
UNK641 (UG/G)	90137		
UNK651 (UG/G)	90110		
UNK653 (UG/G)	90112		
UNK647 (UG/G)	90109		
UNK598 (UG/G)	90056		
UNK603 (UG/G)	90060		
UNK607 (UG/G)	90064		
UNK568 (UG/G)	90037		
UNK573 (UG/G)	90100		
UNK631 (UG/G)	90083		
UNK613 (UG/G)	90069		
UNK628 (UG/G)	90081		
UNK582 (UG/G)	90045		
UNK592 (UG/G)	90103		
UNK596 (UG/G)	90055		
UNK524 (UG/G)	90015		
UNK642 (UG/G)	90108		
UNK555 (UG/G)	90097		

\* Source: ESE, 1986, RIC#87014R21A

# ENVIRONMENTAL SCIENCE & ENGINEERING

PROJECT NUMBER 14936300  
 FIELD GROUP: UNCL\*  
 PARAMETERS: ALL SAMPLES: ALL

11/14/85

STATUS: PRELIMINARY

PROJECT NAME SECTION 36 RMA  
 PROJECT MANAGER: BILL FRASER  
 FIELD GROUP LEADER: GEISZLER/BERGDOLL

## SAMPLE NUMBERS

PARAMETERS	SIGRT #	DATE	TIME
UNK586 (UG/G)	3053	04/29/85	1509
UNK533 (UG/G)	498653		

\* Source: ESE, 1986, RIC/87014R21A

**APPENDIX 36-8-C**  
**COMMENTS AND RESPONSES**



Table 1-A  
Bulk Soil Sample Composition

Element	Average Concentration Bulk Soil (ppm)	ESE Detection Limit (ug/g or ppm)
Cadmium	<0.9	0.9
Chromium	14	7.2
Copper	10	4.8
Lead	<17	17
Zinc	40	16
Arsenic	<4.7	4.7
Mercury	<0.05	0.05

Source: ESE, 1986

Table 1-B

## Summary of Geochemical Data for Nonsource Areas of the

## Rocky Mountain Arsenal

(ug/g or ppm; arithmetic means)

Element	# Samples	# > D.L.	Range	Median	Mean	Standard Deviation	% Detectable	ESE Detection Limits	Recommended Indicator Limits
Arsenic	798	80	25-50	5.6	6.8	7.2	10%	4.7	D.L.-10
Cadmium	798	12	.66-7.8	2.1	2.7	2.3	2%	0.9	D.L.-2
Chromium	798	580	6.4-55	13	14	4.4	73%	7.2	25-40
Copper	798	620	5-46	11	12	5.7	78%	4.8	20-35
Mercury	798	27	.05-1.2	0.087	0.20	0.26	3%	0.05	D.L.-0.1
Lead	798	190	10-120	17	19	10	24%	17	25-40
Zinc	798	682	11-280	41	42	18	85%	16	60-80

D.L. = Detection limit

Table 1-C

Suggested Indicator Levels (IL) for RMA Soils  
Based on Statistical Analysis of USATHAMA Data

Metal	Suggested IL (0-1 ft)	Army IL
Arsenic	10	4.7-10
Cadmium	1-2	1-2
Copper	25	20-35
Chromium	19	25-40
Mercury	0.05-1	0.05-0.1
Lead	27	25-40
Zinc	79	60-80

07/21/88

Kabata-Pendias, A. and Pendias, H. 1984. Trace Elements in Soils and Plants. CRC Press Boca Roton, Florida, p. 315.

O'Leary, R.M., and Meier, A.L. 1986. Analytical Methods Used in Geochemical Exploration, 1984. USGS Circular No. 948.

Shackletter, H.T. and Boerngen, J.G. 1984. Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States. USGS Professional Paper 1270.

Wedepohl, K.H., ed. 1970. Handbook on Geochemistry. Springer-Zerlay, Berlin, West Germany.

Comment 20:  
p. 17

Figure 36-8-6a and Shell Comment No. 2 on Site 36-8 Draft Final CAR. The Army asserts that the "undocumented line" (see 36-20 Task 1, page 9) is being investigated as a part of Task 10. This line was not originally a part of Task 10, and no formal proposal to add this work to Task 10 has ever been received for review. Shell requests that Army provide the relevant documentation for review.

Response:

The 30-inch chemical sewer line leading to the lime settling pits, which was also used to transport surface runoff to Basin A and the 1975 bypass canal, will be investigated under Task 10. A discussion of this line will be included in the updated history of Site 36-8.

Comment 21:  
p. 20,  
first full  
paragraph

In Site 2-3, Lagoon Area, additional sampling was justified based on the tentative identification of an unknown "polychlorinated aliphatic and an aldrin isomer". Is this situation distinguishable?

Response:

Although pentachloro (trichloroethenyl) benzene was tentatively identified in Boring 3181 (0 to 1 ft), the low concentration (0.5 ppm) does not allow for a positive identification. This compound was not detected in the 4- to 5-ft interval of Boring 3181 or in the other Phase I samples along the ditch. Based on the lack of lateral and vertical distribution of pentachloro (trichloroethenyl) benzene as well as its low concentration, further investigation of this postulated identification was not necessary. In the case of Site 2-3, Phase I data were not available to assess the vertical distribution of the two nontarget compounds. The higher concentration of the aldrin isomer (2 ppm) coupled with the identification of a related contaminant, however, did warrant further investigation.



# COLORADO DEPARTMENT OF HEALTH

Richard D. Lamm  
Governor

Thomas M. Vernon, M.D.  
Executive Director

May 7, 1986

Mr. Donald Campbell  
Office of the Program Manager  
RMA Contamination Cleanup  
Department of the Army  
Aberdeen Proving Ground  
Maryland, 21010-5401

Dear Mr. Campbell:

Enclosed are our comments on the Phase II, Section 36, Draft Final Source Report, 36-5, 36-8, 36-10, 36-11, 36-20, 36-21, and 36-22. This document includes a very brief discussion of the general approach for conducting Phase II investigations and a proposal for Phase II "indicator levels" for all future source area investigations.

As we stated in our preliminary comments transmitted to you on April 2, 1986, we do not concur with the proposed Phase II approach and specifically with the proposed inorganic indicator levels. It was not at all clear in the report how the indicator levels for the metals were determined. At the April 22, 1986 MOA Onpost Task Group Meeting, Mr. Kevin Blose stated that the proposals for the Phase II approach and indicator levels were generated together by the Army and the U.S. EPA. We were told that this occurred at "numerous meetings in the past several months" between the Army Staff, the Army's remedial contractors and Mr. Jim Baker, the EPA Region VIII toxicologist. Since we were not present at any of these meetings, we are formally requesting that you provide to us the minutes and any handouts from each of the meetings so that we may better understand the reasoning behind the Army and EPA's Phase II proposals.

Thank you for your consideration in this matter.

Sincerely,

Thomas P. Looby  
Remedial Programs Director

TPL:CS/ras

cc: Howard Kenison, Colorado Attorney General Office  
Bob Duprey, U. S. EPA, Region VIII  
Bob Lundahl, Shell Chemical Co.

COLORADO DEPARTMENT OF HEALTH  
FINAL COMMENTS ON THE TASK 1 CHEMICAL DRAINAGE DITCHES

FINAL SITE REPORT 36-8

1. P.36-8-17 The monitoring well #1 location on this figure doesn't correlate with Figure 36-5-6. All monitoring wells need to be labeled.
2. P.36-8-17 Previous ground water data collected in 1979, 1983, and 1984 show substantial DBCP contamination (195 ppb) at well #1 and volatile organic contamination at well #76 yet soil samples were not collected in the vicinity of this known contamination. Phase II analytic program sampling should be conducted into the uppermost ground water system in these areas for volatiles and DBCP.
3. P.36-8-22 Table 36-8-3 shows an increase in metals with depth in many cases. Why then isn't the 9-10 ft. interval being sampled more frequently for arsenic and mercury in Phase II?
4. P.36-8-23 Same question as above.
5. P.36-8-24. There is no support for the statement "As elevated concentrations of arsenic and mercury were found in the 0 to 1 ft. and 4-5 ft. samples, therefore, only 0 to 1 ft. and 4 to 5 ft. samples in Phase II will be tested for arsenic and mercury." First, bores 3181 and 3183 were not sampled at the 10-11 ft. interval, yet bore 3181 shows mercury increasing with depth and bore 3183 shows arsenic increasing with depth (p. 36-8-11). In bore 3182, mercury was detected at the 10-11 ft. interval (p. 36-8-11). Finally, in wells 4 and 36 arsenic was measured at

0.89 ppb and 0.65 ppb, respectively. Based on the data, arsenic and mercury should be tested for at depth, just the opposite of the above statement.

6. P.36-8-24

The source estimates given in Section 3.1.4 are based on only 2 deep core samples (9-10 ft.) collected along 3600 linear feet of trench. This is insufficient for evaluating the extent of contamination with depth for this source.

FINAL RESPONSE TO COMMENTS OF  
COLORADO DEPARTMENT OF HEALTH

FINAL SITE 36-8 REPORT

General comments made in the cover letter by Colorado Department of Health were discussed at the MOA meeting on June 3 and 4, 1986. A final response to these comments is included within the minutes of the MOA meeting. The following responses address the preceding specific comments from Colorado Department of Health on the final Site 36-8 Report.

1. P.36-8-17           The monitoring well locations shown on the figures were incorrect in the previous report draft. A new Figure 36-8-3 has been included and shows the correct locations and numbers for relevant wells.
  
2. P.36-8-17           Historical ground water data in the southwestern corner of Section 36 has shown evidence of contamination. Extensive ground water monitoring is being conducted in this area. In addition, saturated soil and water samples from several locations in Section 36 are being taken in an attempt to determine distribution coefficients ( $k_d$ ) for important contaminants. Phase II soil sampling in the saturated zone for Site 36-8 is not considered necessary or appropriate for investigating ground water conditions in this area.
  
3. P.36-8-22           Arsenic and mercury concentrations are increasing with depth, thus, the Phase II plan has been revised to include arsenic and mercury analyses at all depths.
  
4. P.36-8-23           Arsenic and mercury concentrations are increasing with depth, thus, the Phase II plan has been



revised to include arsenic and mercury analyses at all depths.

5. P.36-8-24 Arsenic and mercury concentrations are increasing with depth; thus, the Phase II plan has been revised to include arsenic and mercury analyses at all depths.
6. P.36-8-24 The depth figure used in calculating the volume of potentially contaminated soil is the depth to water. It is, in this case, not based on the chemical analysis results, except, as they indicate potential contamination throughout the unsaturated zone. Thus the volume represents, as stated, the estimated volume of soil above the water table which may be contaminated for this site. We agree this is based on few data points. That is why it is called an estimate and a Phase II study is being proposed.

# Shell Oil Company



One Shell Plaza  
P.O. Box 4320  
Houston, Texas 77210

April 7, 1986

USATHAMA

Office of the Program Manager  
Rocky Mountain Arsenal Contamination Cleanup  
ATTN: AMXRM-EE: Chief: Mr. Donald L. Campbell  
Building E4585  
Aberdeen Proving Ground, MD 21010-5401

Dear Mr. Campbell:

We submit herewith Shell's comments on the draft final copies of Contamination Assessment Reports on Section 36, sources 36-5, 36-8, 36-10, 36-11, 36-12, 36-20, 36-21, and 36-22, February 1986.

In view of the limited time available for review, Shell may have additional comments at a later date. Also, since as indicated in your March 11, 1986 cover letter, this first group of reports represents relatively straightforward contamination results and uncomplicated Phase II sampling design, it may not expose substantive issues which may arise in the later more complex source assessments. For this reason also we reserve the right to make additional comments at a later date.

General comments which apply to the methodology and data presentation of all reports are provided below. Comments on specific sources are attached.

Our most serious concern with your assessment approach is with the derivation of background levels ("Indicator Levels") as described in the Executive Summary.

- For all seven of the trace metals, the indicator levels selected are greater than the facts presented can support. This is due partly to the use of national and regional background statistics (literature sources) in guiding the selection of the indicator levels. Comparison of local background data (bulk soil sample and soil from "uncontaminated" areas) clearly shows that the literature statistics are not representative of the RMA environment, i.e., they indicate higher background levels.
- Some of the soil analyses of "uncontaminated" areas (Table 4) used in guiding the selection of indicator levels can be expected to include a contaminant component in addition to natural background.

BIIM8609206

This may be especially true for mercury and arsenic based on Section 36 Phase I data which indicates frequent occurrences of these metals at shallow levels. This would tend to increase apparent natural background levels.

- The highest measurements (upper 20%) for each metal in the "uncontaminated" soil samples appear to have keyed the lower bound of the selected indicator level. The upper bounds (excepting zinc) range from a factor of 1.6 to 2.5 of the lower bound. This results in too broad a range in which proposed decisions will be made on the Phase II investigation.
- Shell's proposals for indicator levels are developed in comments under the Executive Summary section of the attached comments.

A second concern relates to the presentation (or lack thereof) of data and other information. Certain features of the presentation, listed below, could cause misinterpretation of the data or misdirection of subsequent work efforts.

- Sampling intervals in each report (e.g., Table 36-5-1) list the planned intervals in the Phase I Technical Plan but the actual depth of the interval was frequently changed in the field (usually because the water table was encountered). Actual depth of sampling should be shown in the reports for each sample.
- Each report includes a table of most recent analyses of groundwater under or near the source area (e.g., Table 36-5-5). Many of these analyses are quite old, up to 8 years, and therefore highly questionable as to interpretive value. Also, since groundwater contamination at any point frequently reflects contaminants up dip of the area, it is difficult to see how inclusion of groundwater analysis can provide insight to contamination on a localized basis. Groundwater data should not be included unless inferences can reasonably be made from it.
- Soil samples taken near the water table may reflect contaminants from the underlying groundwater (by volatilization or level fluctuation) as opposed to contamination from the surface. This should be suspected especially when volatiles are found at this level but not at shallower levels. See for example boring 3136 in Source 36-5. A designator should be used when groundwater contamination is possible.
- Modifications to source area boundaries from the Phase I Technical Plan occur frequently in this set of reports, e.g., Source 36-5 and 36-11. The modifications should be described in the text and reasons stated.

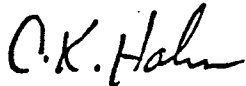
- In designing Section 36 Phase II plans, several of the source areas in these reports are redistributed and consolidated with other source areas. This creates multiple source areas for Phase II study but the title of the expanded sources do not reflect this. For example, borings are assigned to Source 36-20 (Chemical Sewer) which are unlikely to have been impacted by the chemical sewer because of lateral distance from it. To avoid misinterpretation of data, adjustments should be made to titles in these instances.

Finally, we would like to comment regarding the Army's screening method whereby the data generated by all samples analyzed for semi-volatile and volatile compounds by GC/MS be examined to identify the unknown present. The issue of identification of unknowns is not a new issue and has been the subject of numerous communications in recent months, in particular with regard to possible degradation compounds from Army surety agents. Shell has provided the Army with a list of compounds which have a high probability of being in the environment.

Unfortunately, the screening techniques utilized by the Army have a low probability of detecting most of the compounds specified by Shell. Most of these compounds would not get through the gas chromatographic columns and would require derivatization to be amenable to the specified analytical techniques. This may account for the fact that, basis the Assessment Reports released thus far, unknowns have not been found, except for naturally occurring organic compounds or impurities introduced during extraction. We recognize that the Army has plans underway to supplement Phase II analytical efforts with several specific target compounds and possible addition of methods for organo-mercury and organo-arsenic compounds. This is a step in the right direction.

We look forward to discussing these comments at a forthcoming On-Post MOA Task Group meeting.

Very truly yours,



C. K. Hahn, Manager  
Denver Site Project  
Manufacturing & Technical

RDL:ajg

Attachment

cc: (w/attachment)

USATHAMA

Office of the Program Manager

Rocky Mountain Arsenal Contamination Cleanup

ATTN: AMXRM-EE: Mr. Kevin T. Blose

Aberdeen Proving Ground, MD 21010-5401

Mr. Thomas Bick  
Land & Natural Resources Division  
U.S. Department of Justice  
P.O. Box 7415  
Benjamin Franklin Station  
Washington, D.C. 20044-7415

Major Robert J. Boonstoppel  
Headquarters - Department of the Army  
ATTN: DAJA-LTS  
Washington, DC 20313-2210

04/14/87

## SHELL OIL COMPANY

SPECIFIC COMMENTS ON  
FINAL SITE 36-8 REPORT

1. Figure 36-8-6B. Why is a transect made at boring 3053 (which was originally in an "uncontaminated" area) when boring 3183 nearby has substantially greater contamination?

It can be assumed that the contaminant plume from a ditch is symmetrical, therefore a transect can be run on only one side of the ditch. This will provide more transects, or closer spacing of borings, for the same number of borings.

2. Figure 36-8-7. Boring 3185 should be on this figure. Borings should be placed around 3185.
3. Figure 36-5-1. Volatile analyses are done on all sample intervals except A in source areas 36-8 and 36-20 and on C level (or deepest) in 36-5, 36-10 and 36-12. What are the criteria for deciding which sample interval will be analyzed for volatiles?
4. 36-8-9. Will contamination above or in the gray lime cake be investigated?
5. Table 36-8-5. Wells listed are not identified in Figure 36-8-5a.
6. 36-8-19, first paragraph The suggestion that the contaminants are derived from disposal activities associated with source 36-8 may be true provided fluctuation of the ground water table does not exceed a couple of feet.

FINAL RESPONSE TO SPECIFIC COMMENTS OF  
SHELL OIL COMPANY

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General comments made in the cover letter by Shell Oil Company were discussed at the MOA meeting on June 3 and 4, 1986. A final response to these comments is included within the minutes of the MOA meeting. The following responses address the preceding specific comments from Shell Oil Company on the final Site 36-8 Report.

1. Figure 36-8-6B. Transects were placed to provide data at the upstream and downstream ends of the ditch which would help define alignment and lateral influence. In this case, symmetry was not assumed, partially because the exact alignment of the ditch is not defined. The boring arrangement shown is thought to be the most economical given site conditions and the questions we are trying to answer.
2. Figure 36-8-7. Boring 3185 was part of the 36-20 investigation and was mislocated in the field, off the 36-20 alignment. Phase II borings for Site 36-20 are located in this vicinity. Boring 3185 is influenced by an abandoned sewer line nearby, which is being investigated under Task 10.
3. Figure 36-5-1. The Contamination Assessment Report Introduction describes the process for determining where volatile analyses were run. Briefly, in sites with a history of volatile disposal, volatile analyses were run on all but the A (surface) interval.

In other sites, volatile analyses were run on 10 percent of the samples. These were selected by the Task Manager to maximize the chance of detecting volatiles if they were present.

The semivolatile GC/MS method applied to all Phase I samples, although not certified for volatile compounds, has been shown capable of detecting tetrachloroethylene, toluene, chlorobenzene, ethylbenzene, and xylenes in the nontarget fraction. The absence of these compounds in the nontarget results for Site 36-8 is an indication that no contamination is present from these compounds.

4. P.36-8-9 The grey lime cake material is associated with Site 36-4 and is scheduled for extensive investigation in Phase II, as described in the 36-4 CAR.
5. Table 36-8-5. The monitoring well locations shown on the figures were incorrect in the previous report draft. A new Figure 36-8-3 has been included and shows the correct locations and numbers for relevant wells.
6. P.36-8-19 We concur with your observation that fluctuating water table elevations could account for some observed contamination beneath Site 36-8. Extensive monitoring and research are ongoing and are examining ground water and soil interactions in this area.